GOMOS overview 2010

Erkki Kyrölä, FMI
GOMOS team
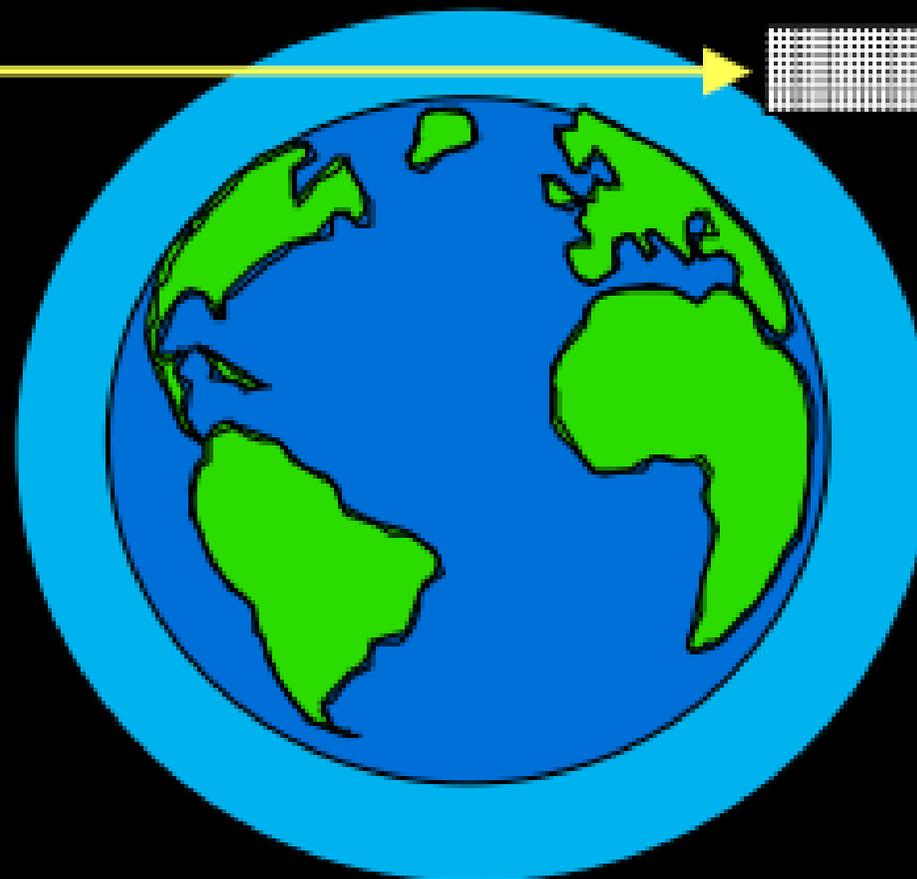
Contents

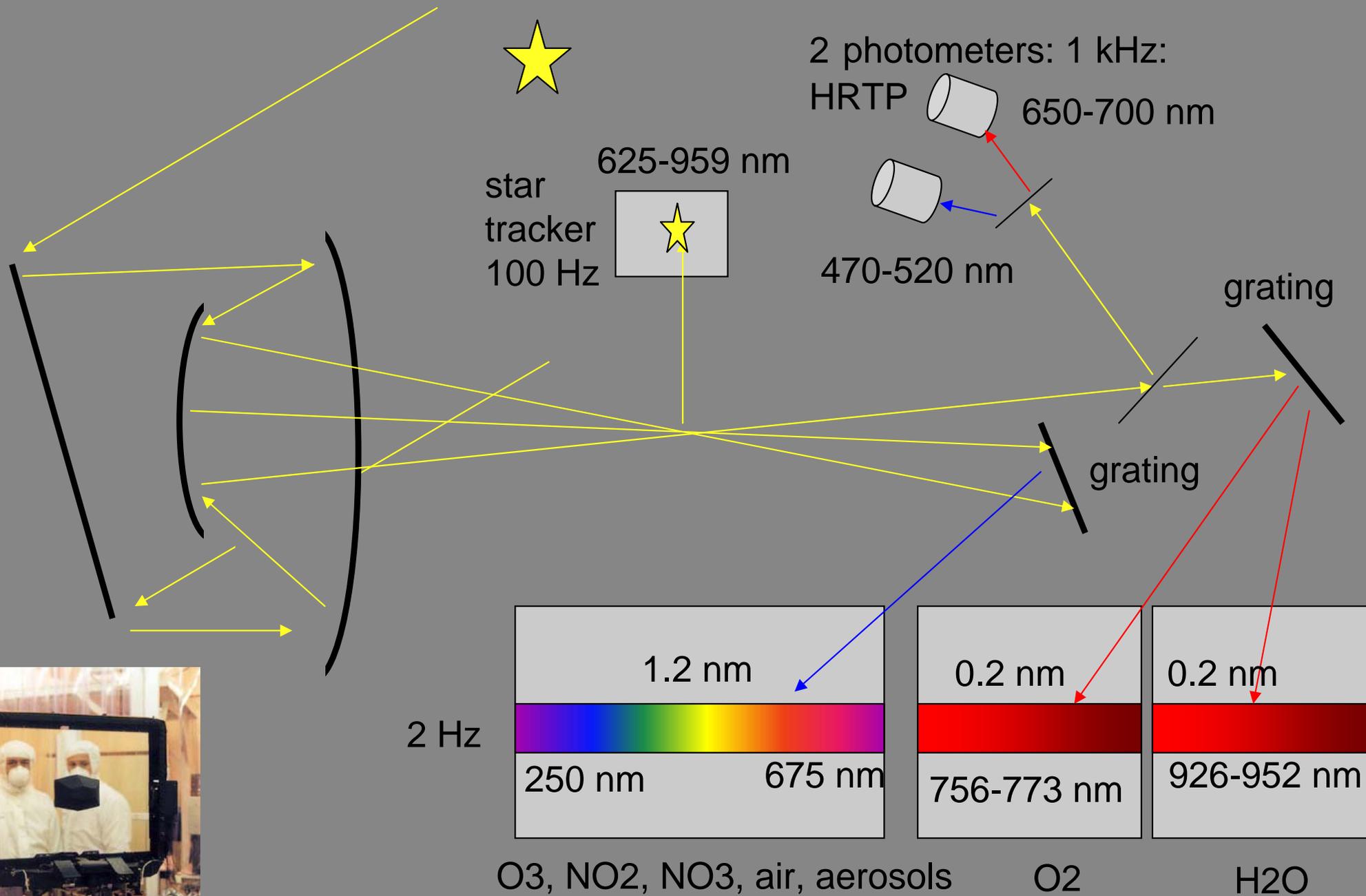Number density vs Altitude (km)
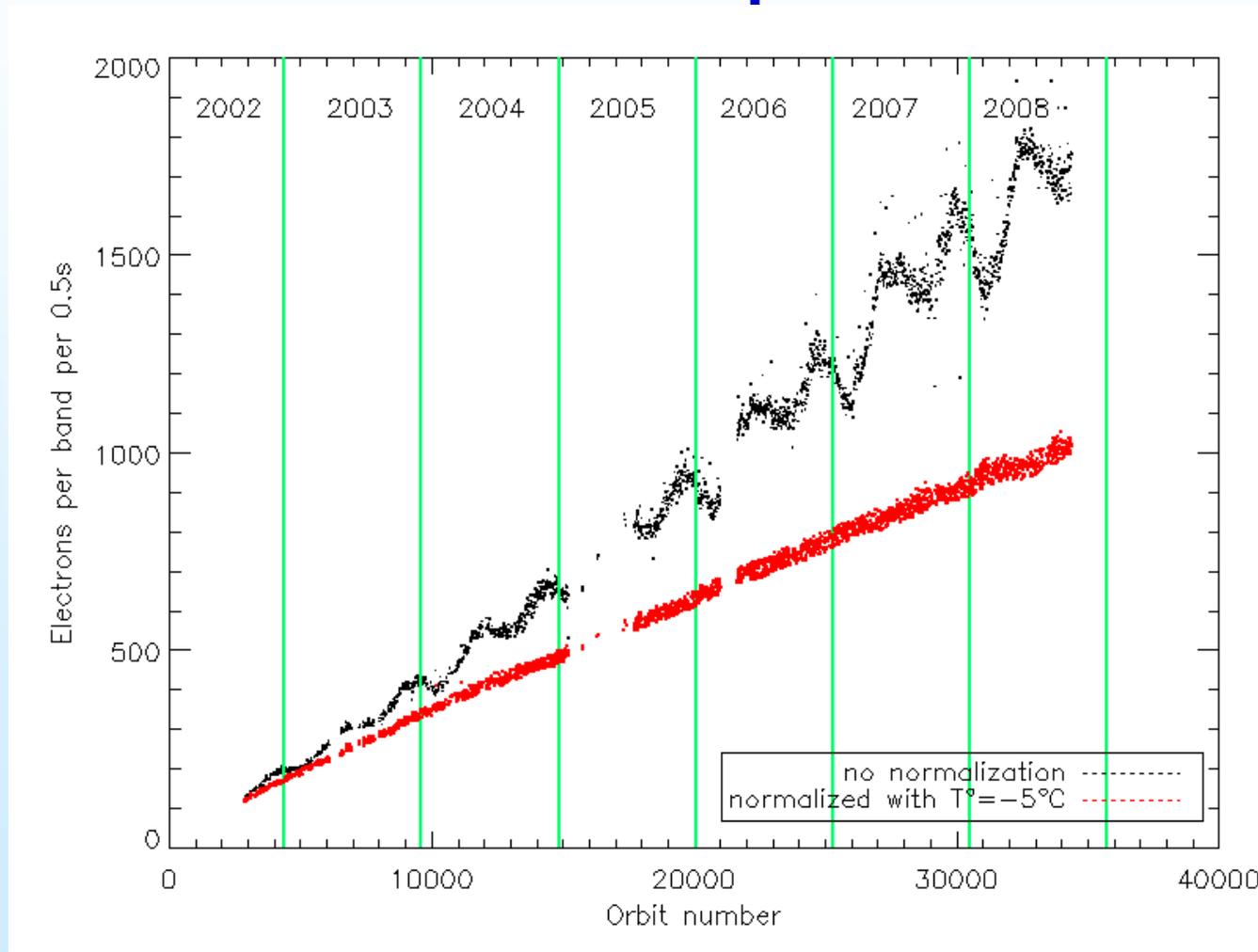
GOMOS mission summary
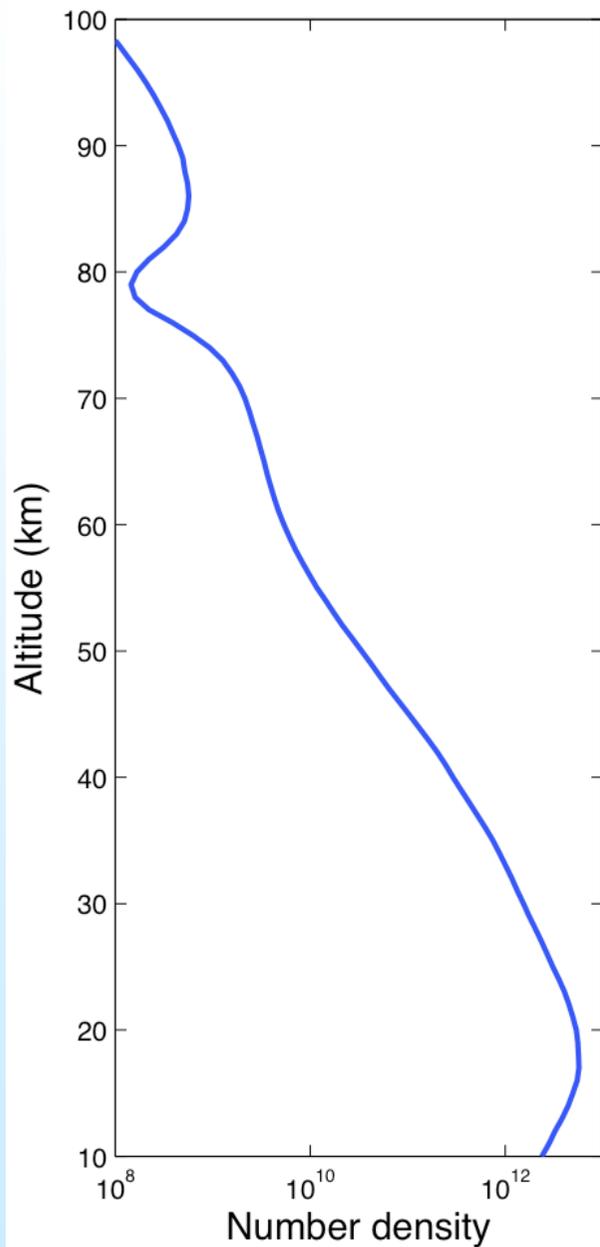
- More than 8 years of measurements
- Number of occultations: > 700 000
- High resolution profiles of O3, NO2, NO3, H2O, aerosols, turbulence, temperature
- Science: Climatologies, time series, third ozone peak, particle effects, turbulence, sodium layer, NLC, OCIO
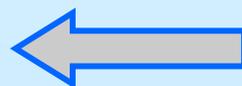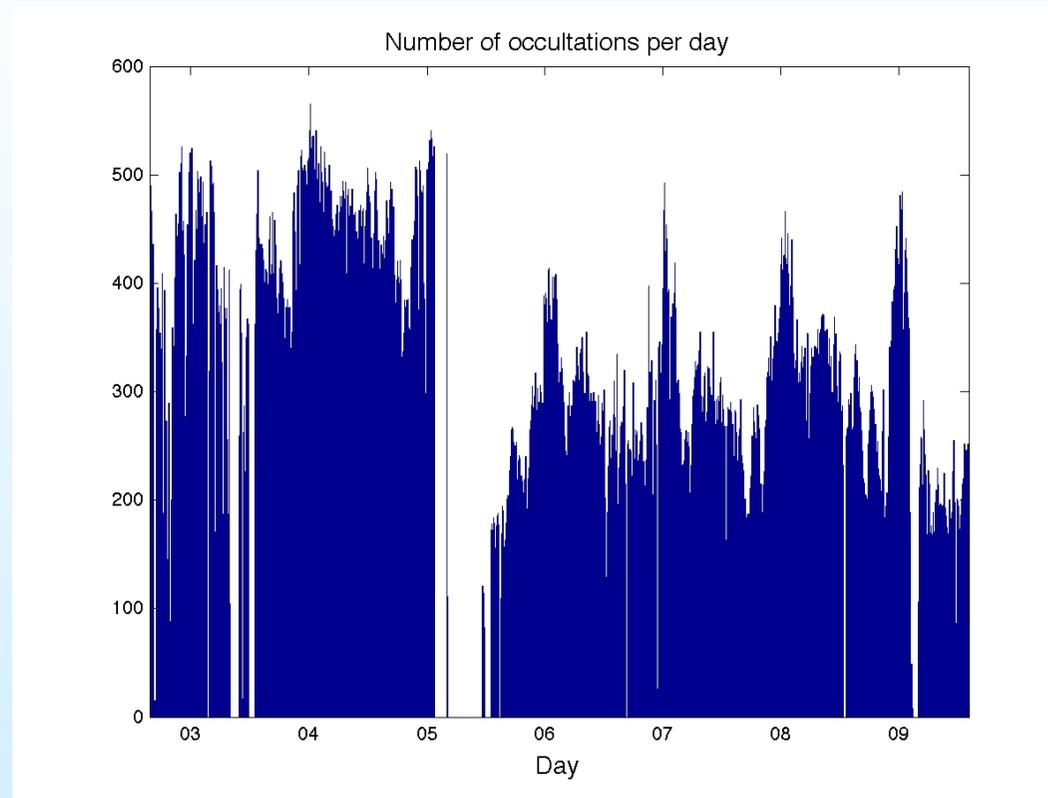
Ozone from 10-100 km with 2-3 km resolution

2 photometers: 1 kHz: HRTP
650-700 nm

625-959 nm

star tracker 100 Hz

470-520 nm

grating

grating

1.2 nm

2 Hz

250 nm   675 nm

0.2 nm

756-773 nm

0.2 nm

926-952 nm

O3, NO2, NO3, air, aerosols   O2   H2O
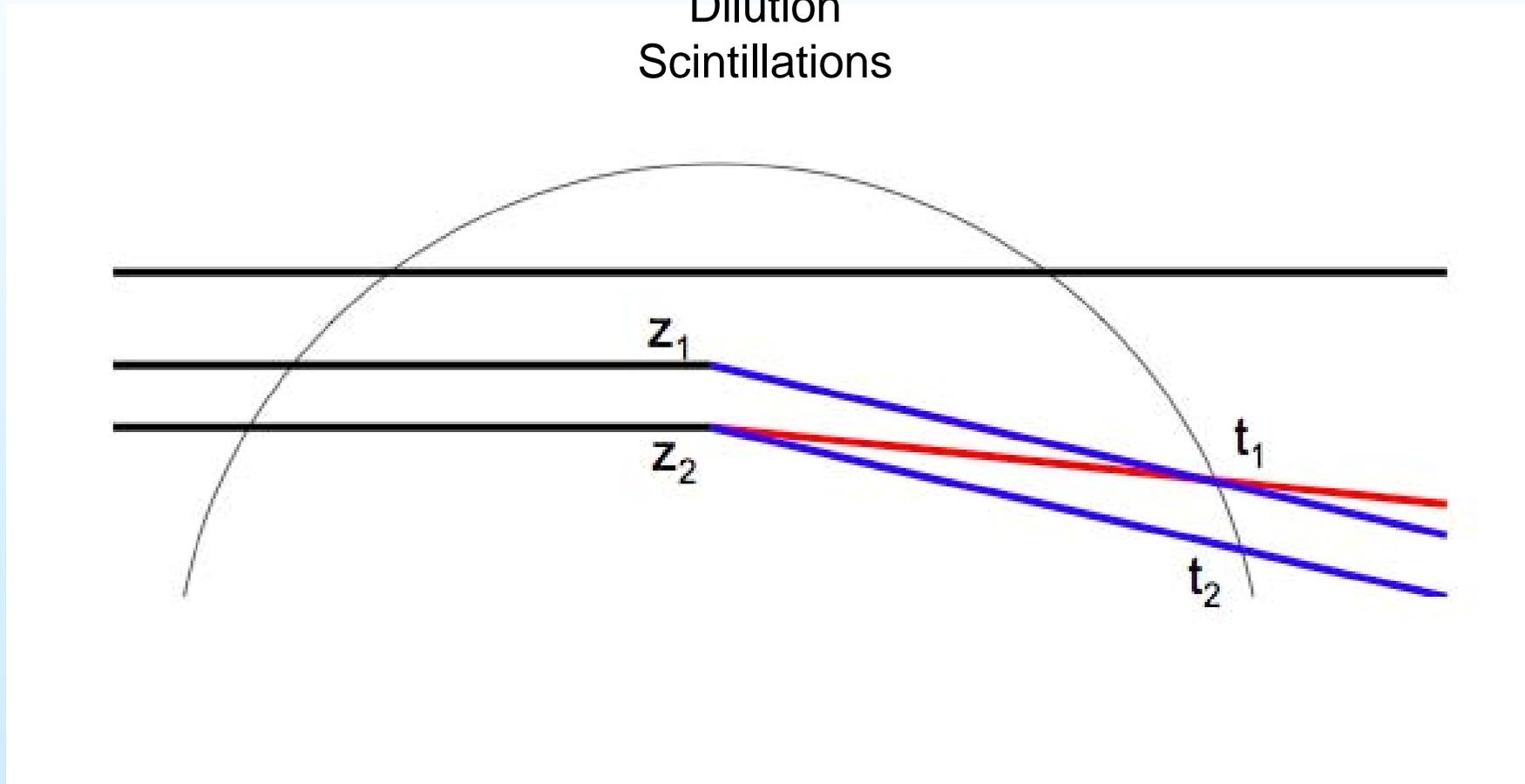
Dark current problem

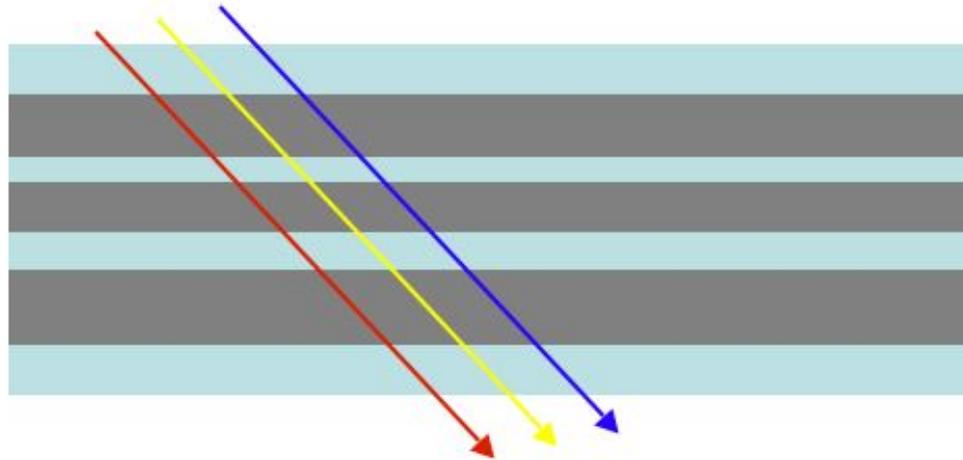# Number of occultations: 668 690 (August 8, 2009)
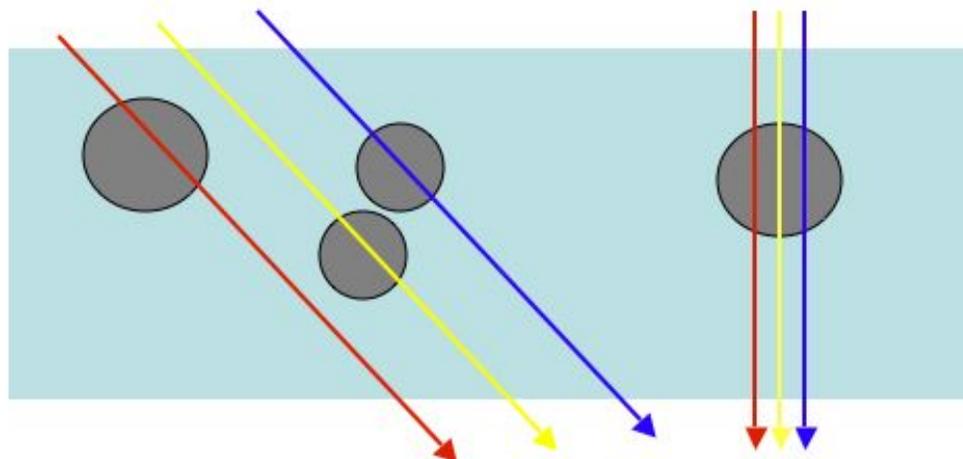
Refraction effects
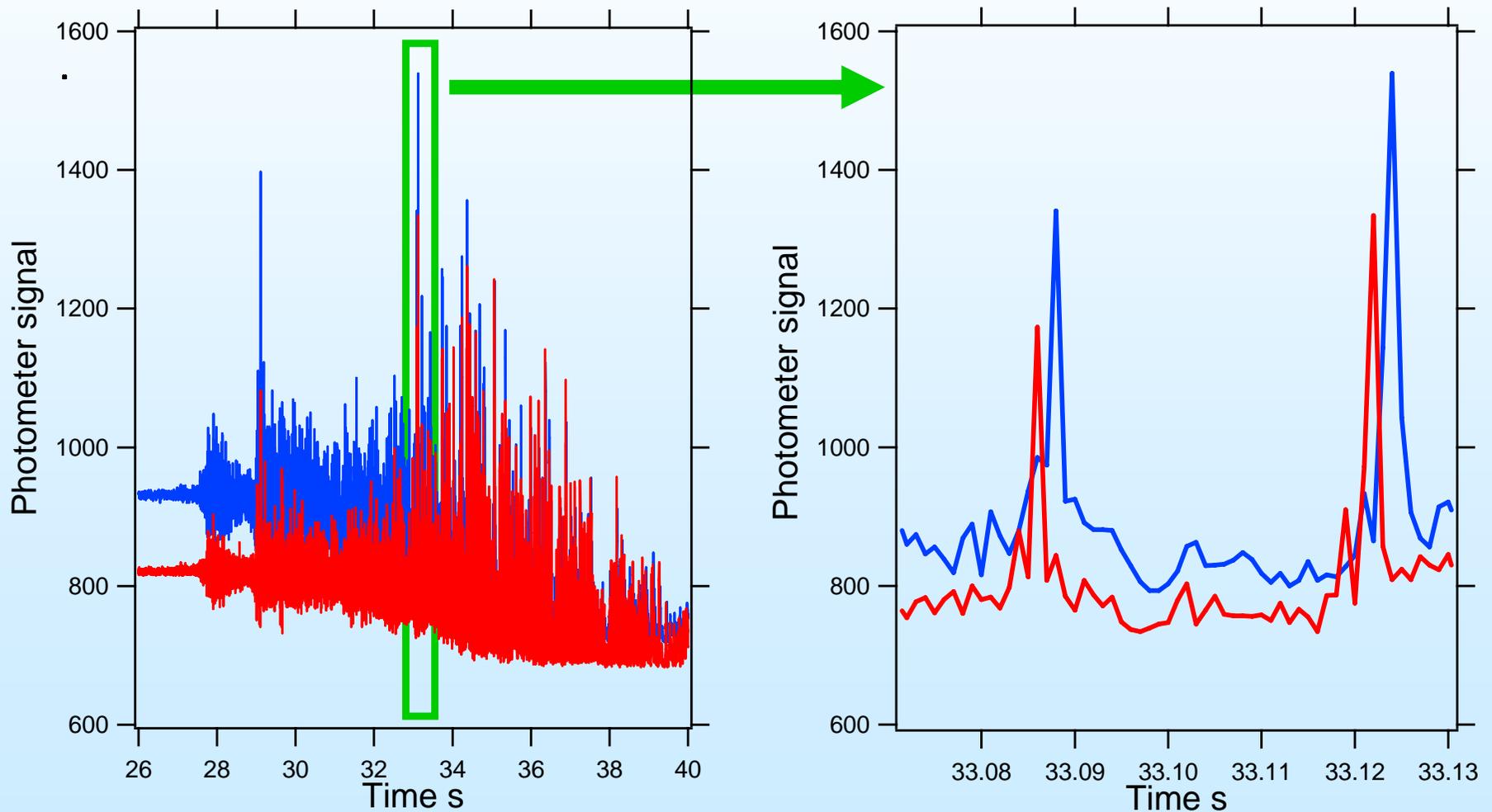
Ray bending
Dilution
Scintillations

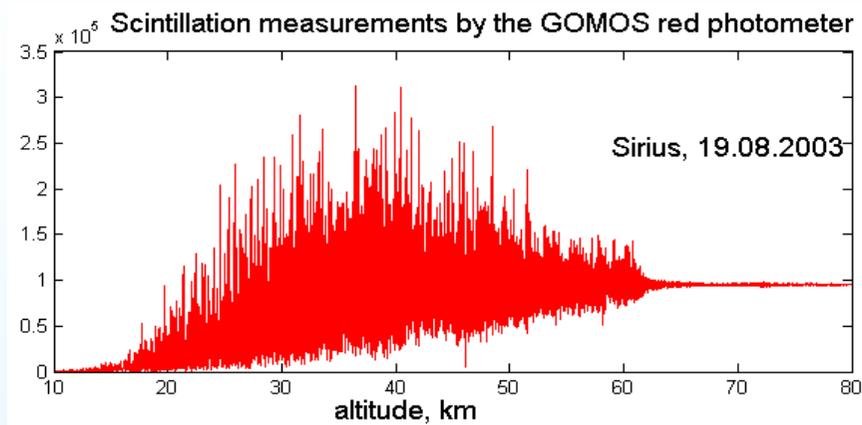Anisotropic scintillation

Isotropic scintillation
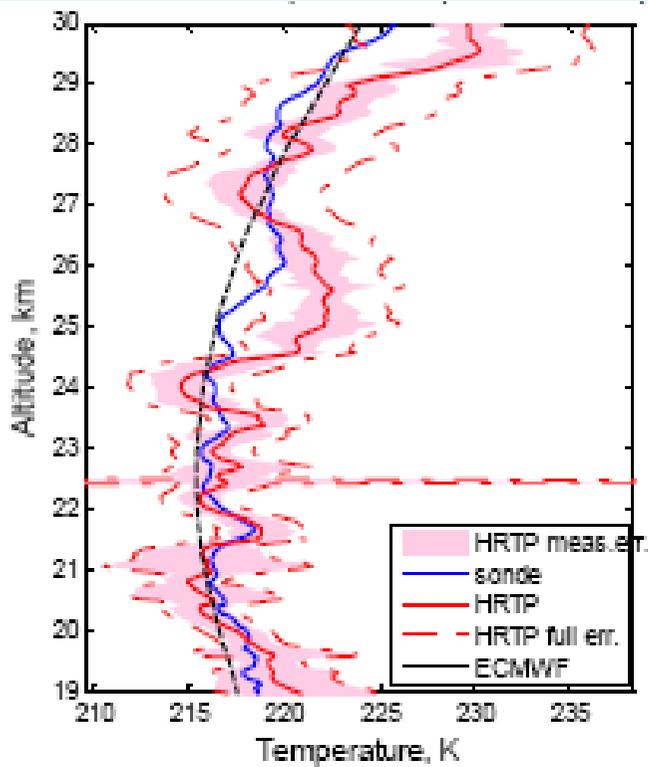
Time delay between the red and the blue photometer

GOMOS scintillation measurements:
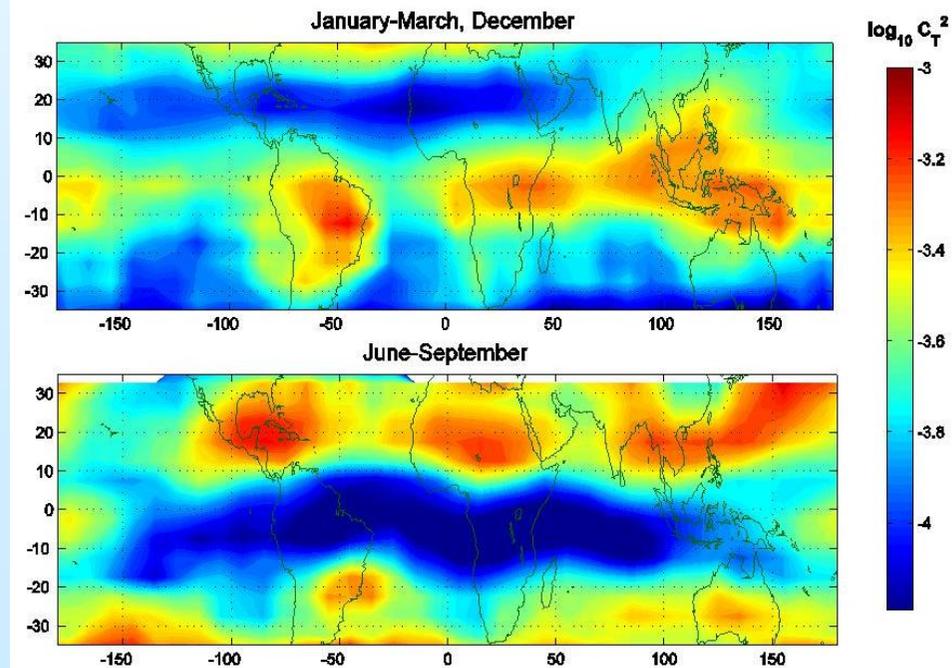# Towards visualization of gravity wave breaking

Star scintillation

Scintillation measurements by the GOMOS red photometer
Sirius, 19.08.2003

Sofieva et al., 2007

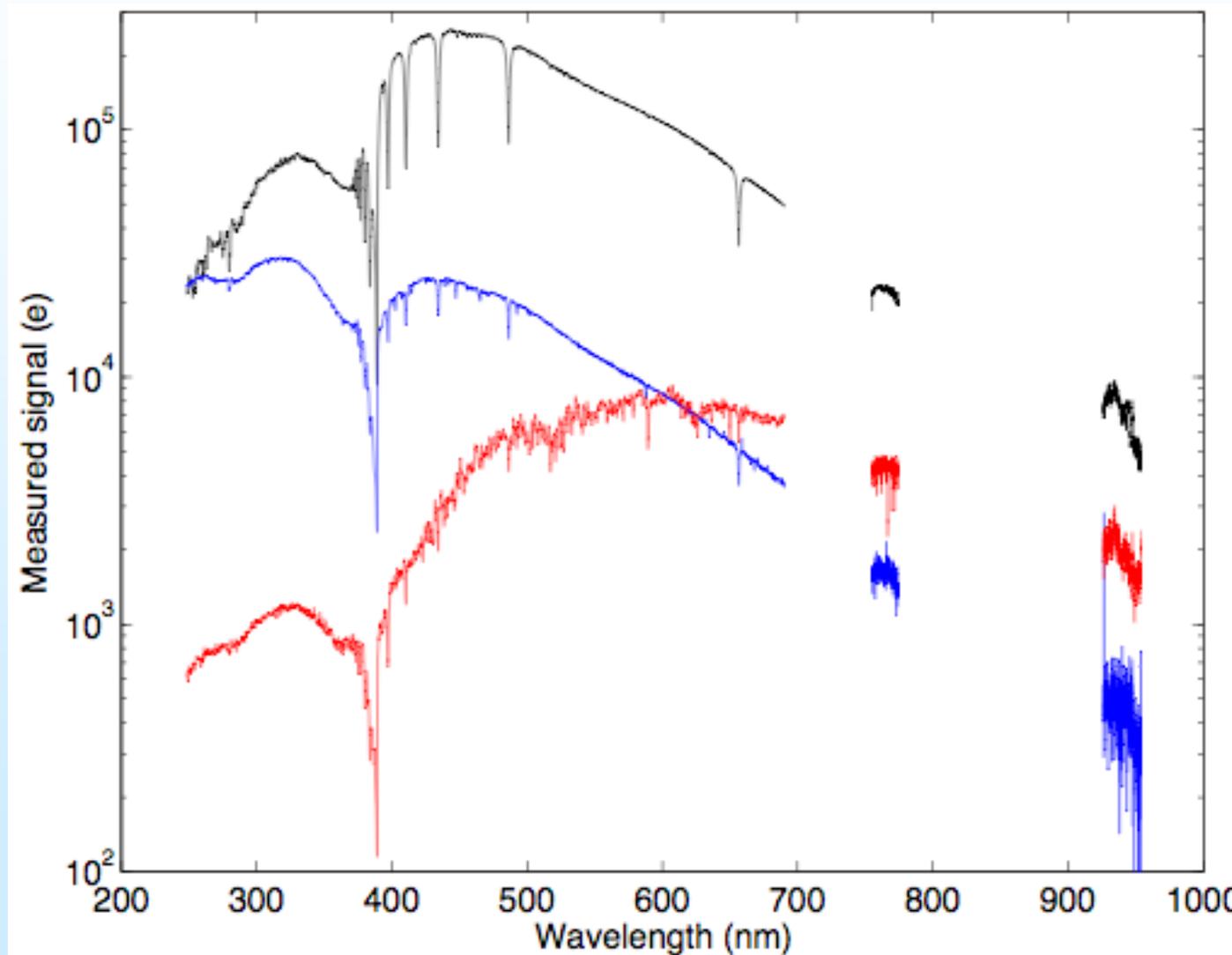**High resolution temperature profile**

Turbulence structure C_T^2

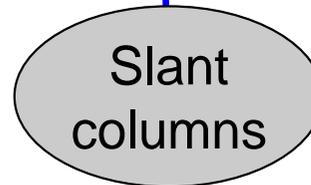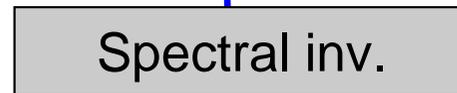Turbulence structure characteristic C_T^2 ($K^2m^{-2/3}$) at 42 km in 2003

180 stars

GOMOS data processing (night)
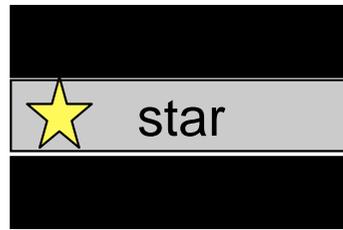
UV-VIS & IR CCDs

star

Photometers

Transmission

Time series

Spectral inv.

scint. corr.

Slant columns

Vertical inv.

HRTP

Turbulence
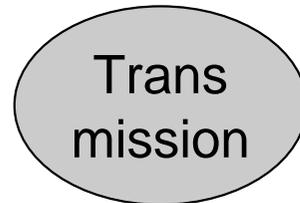
O3, NO2, NO3, air, aerosols, H2O, O2

Vertical profiles
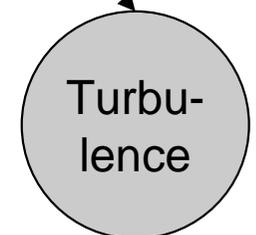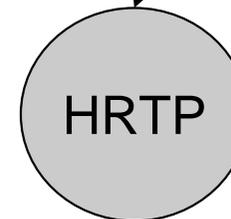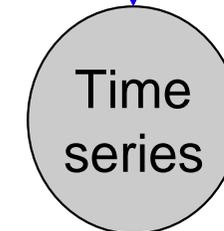
Observed (blue) and refraction corected transmissions (red)
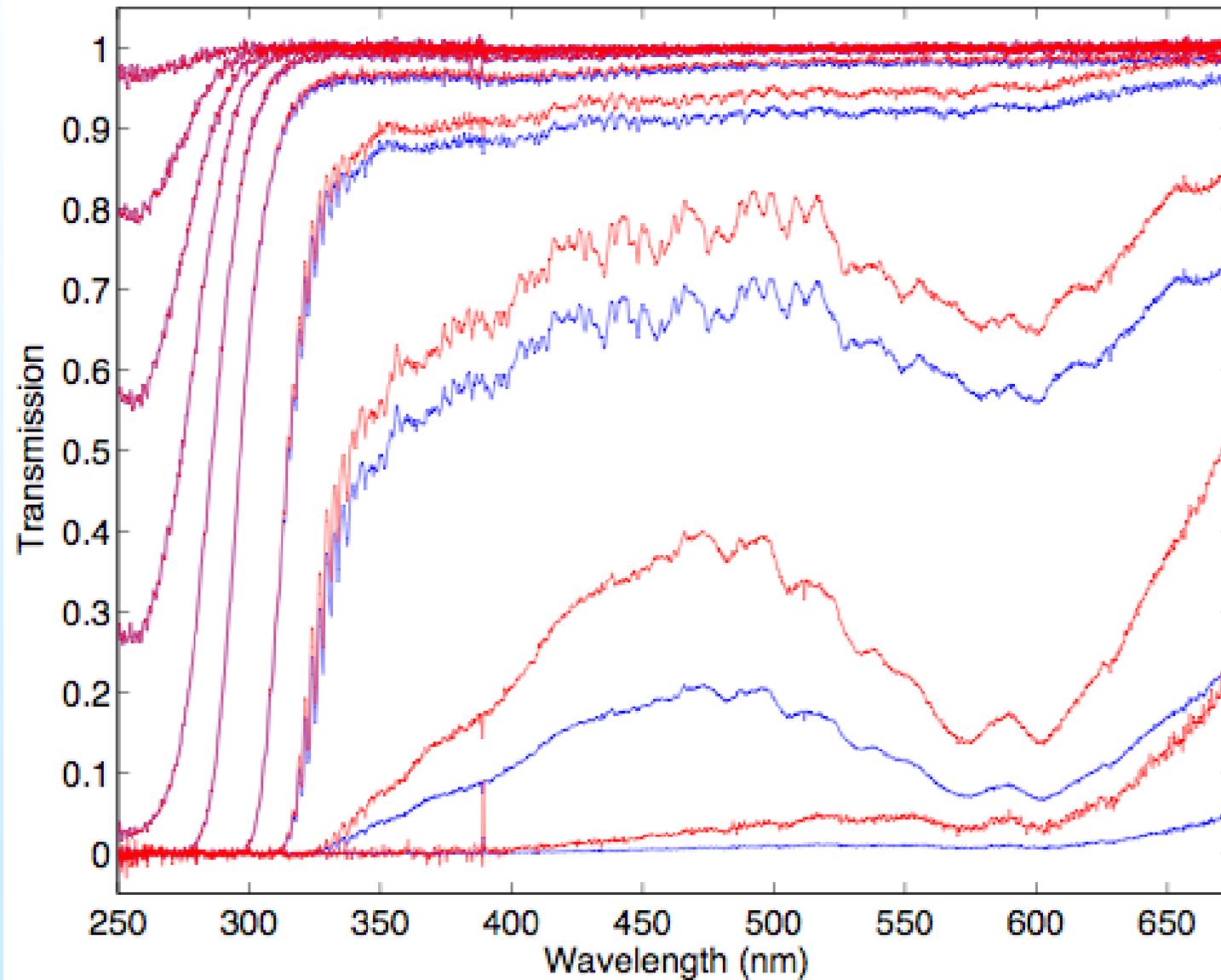
Refraction correction
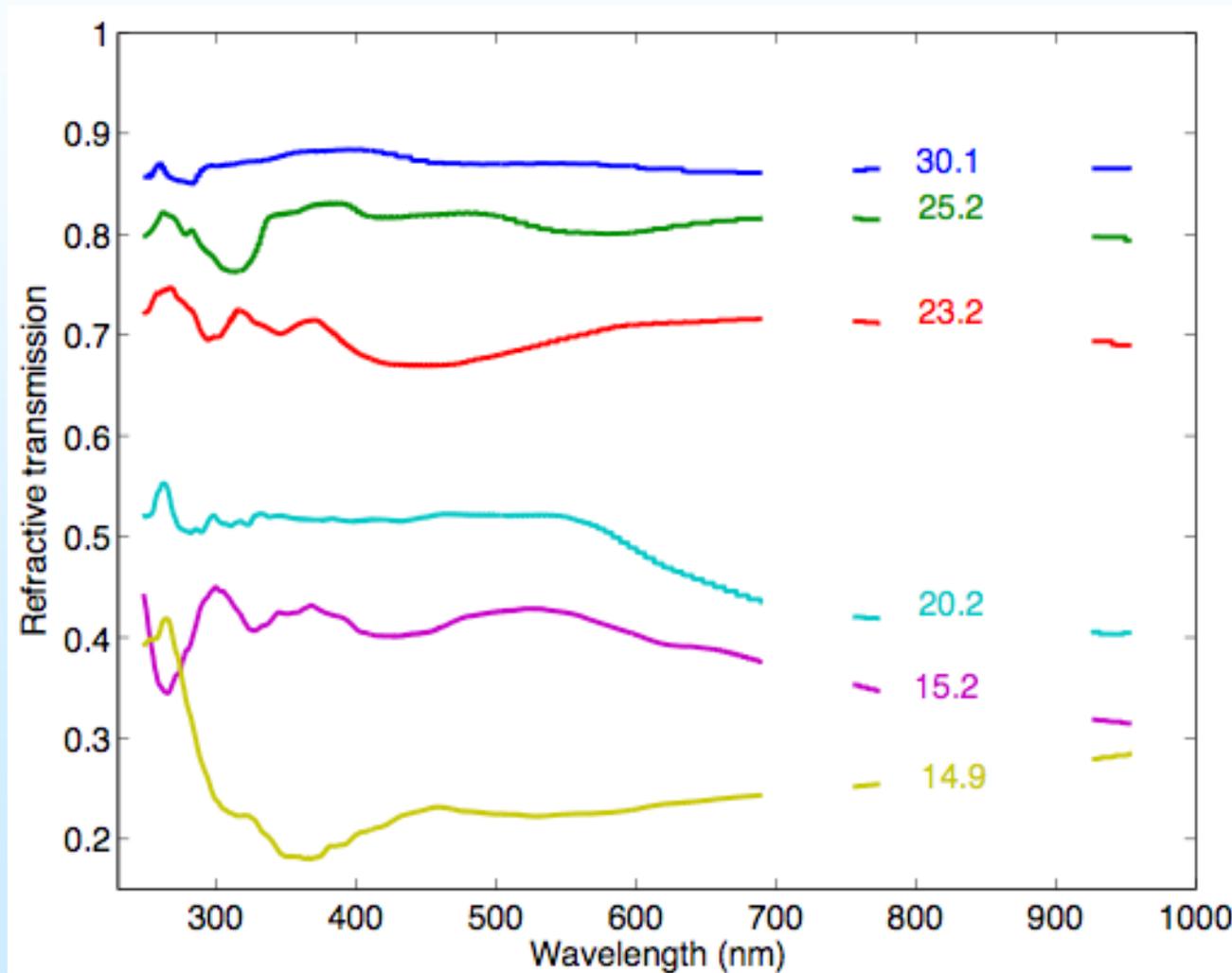
GOMOS : measured species and altitude range
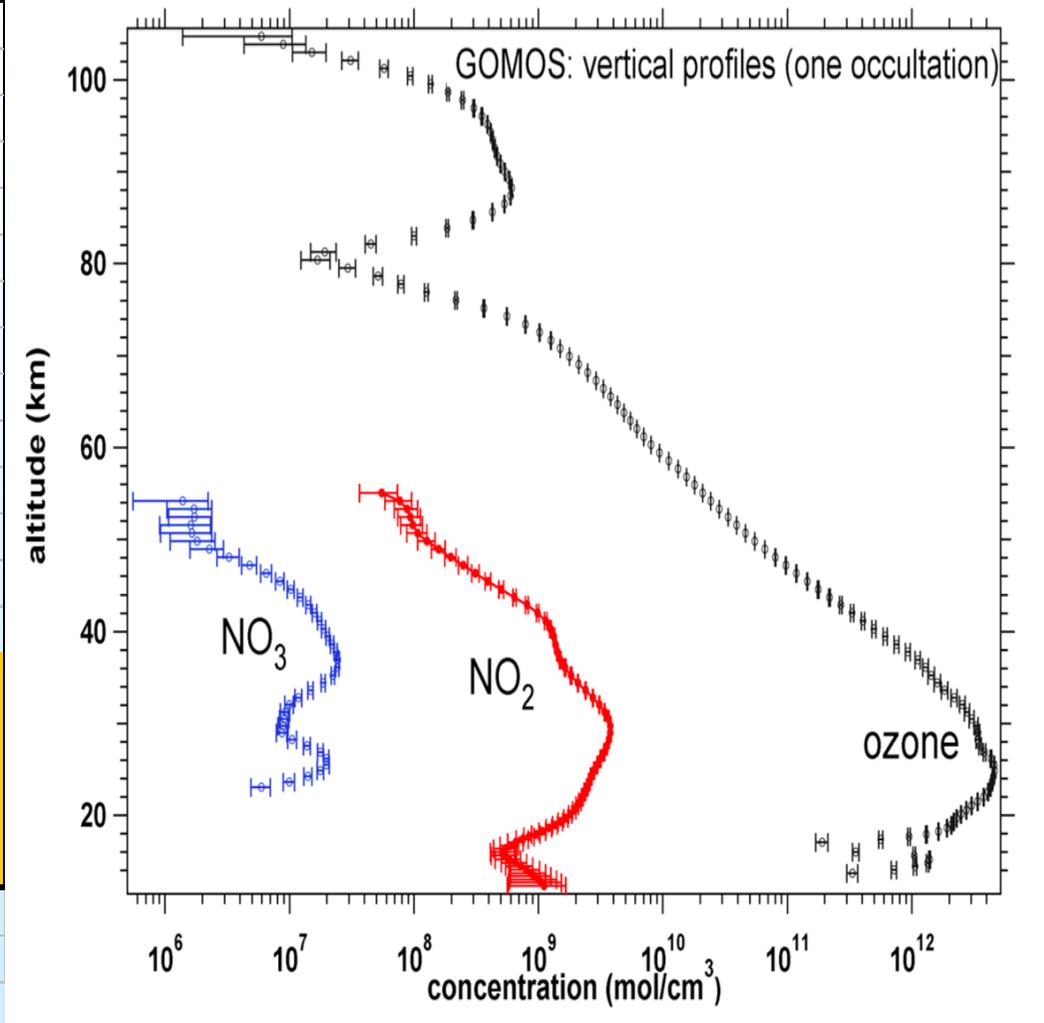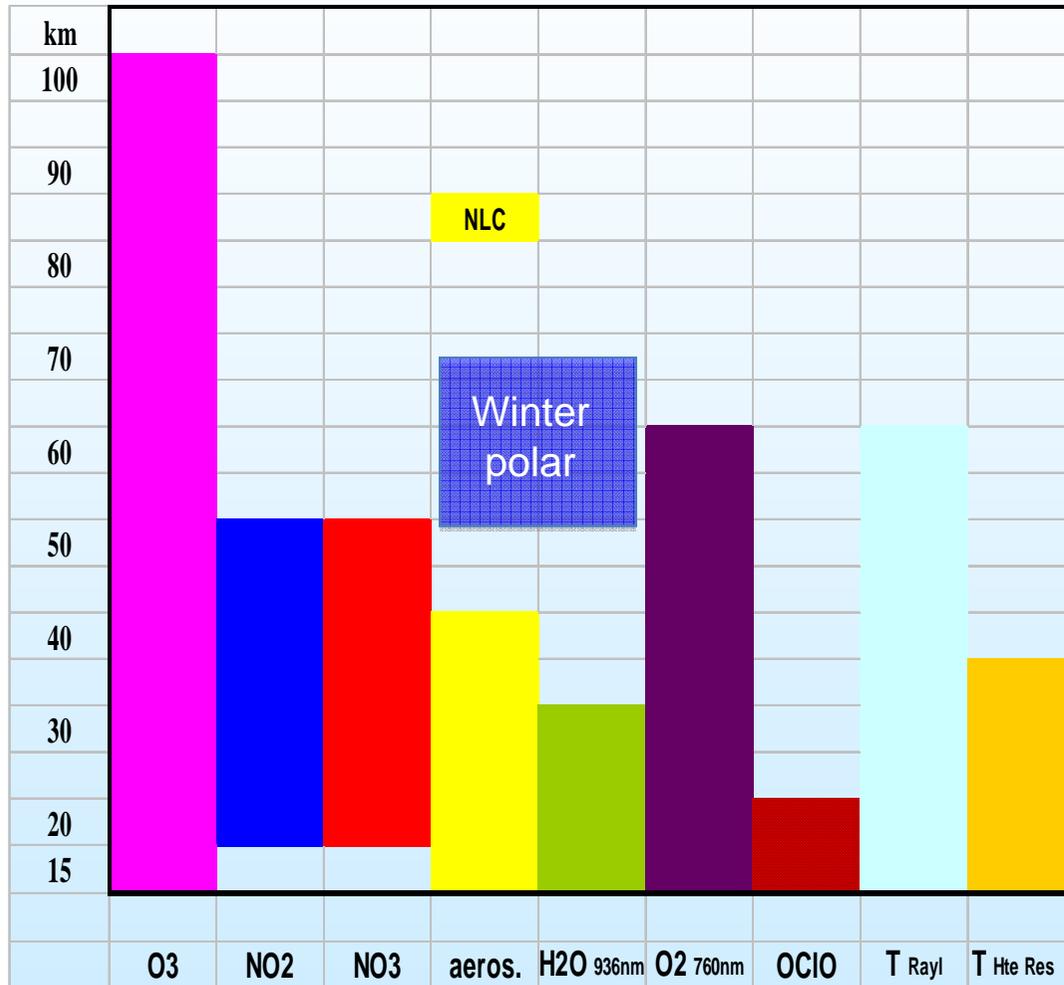
Bertaux et al., 2010

Ozone validation by lidars in 2002-2009

Anne van Gijsel
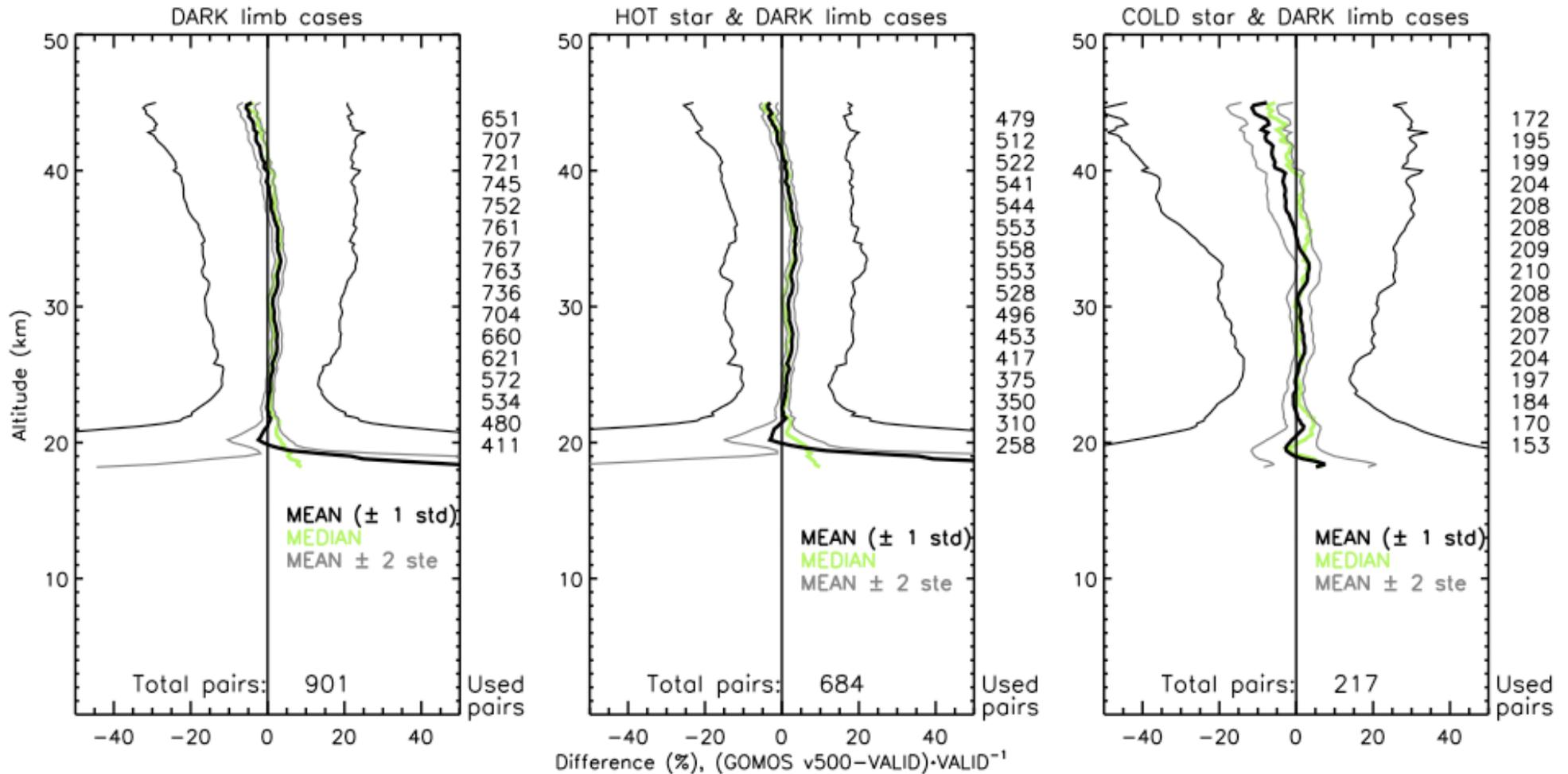
O_3, NO_2, NO_3

Global climatologies
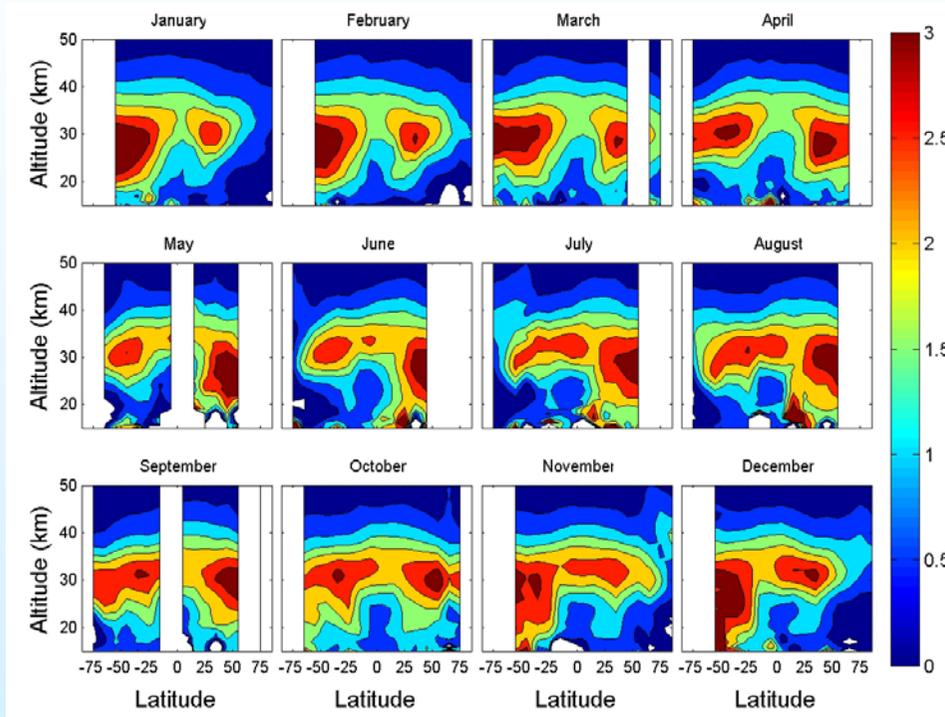
Time series analysis

http://fmilimb.fmi.fi/

Annual, semi-annual, solar, QBO
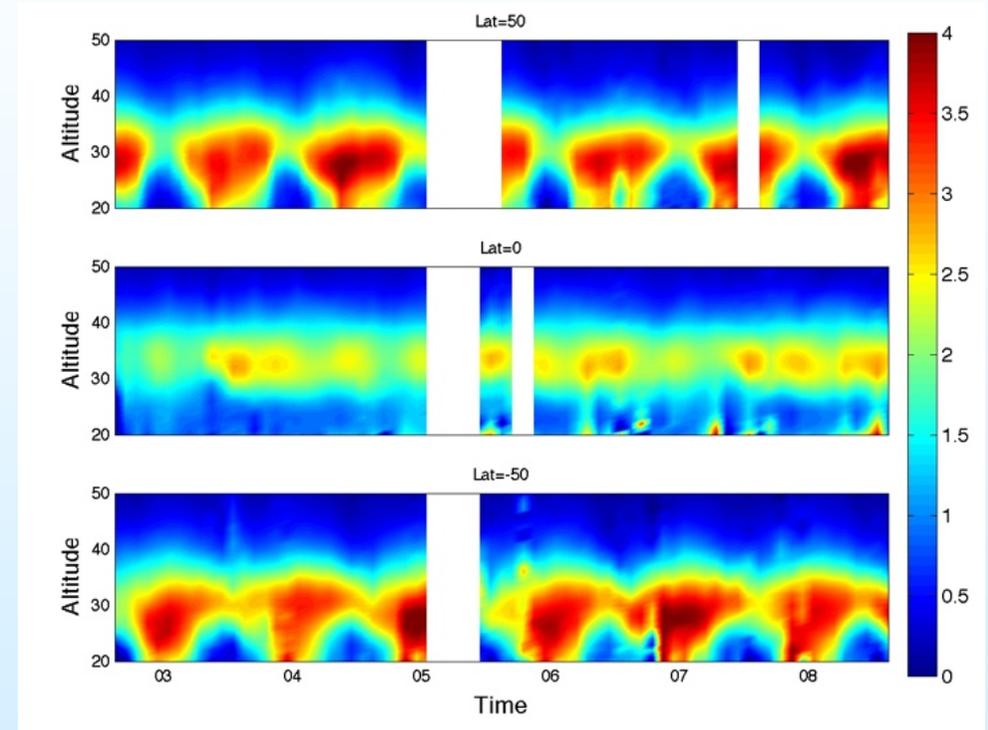
Hauchecorne et al., JGR., 110, D18301, 2005.
Kyrölä, et al., JGR., 111, D24306, 2006.

GOMOS ozone at 90 km in Equator
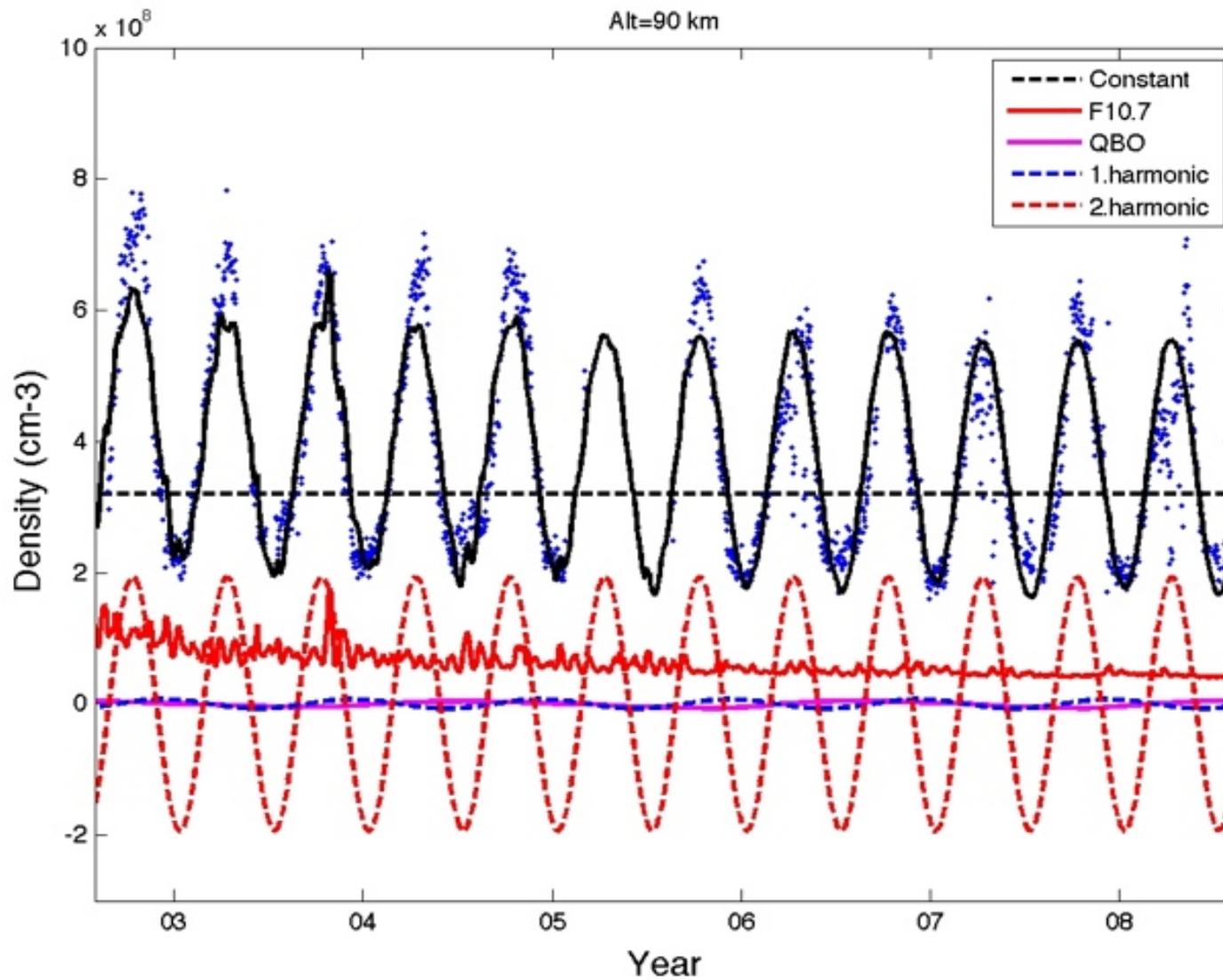
PSCs, stratospheric aerosols, and cirrus clouds
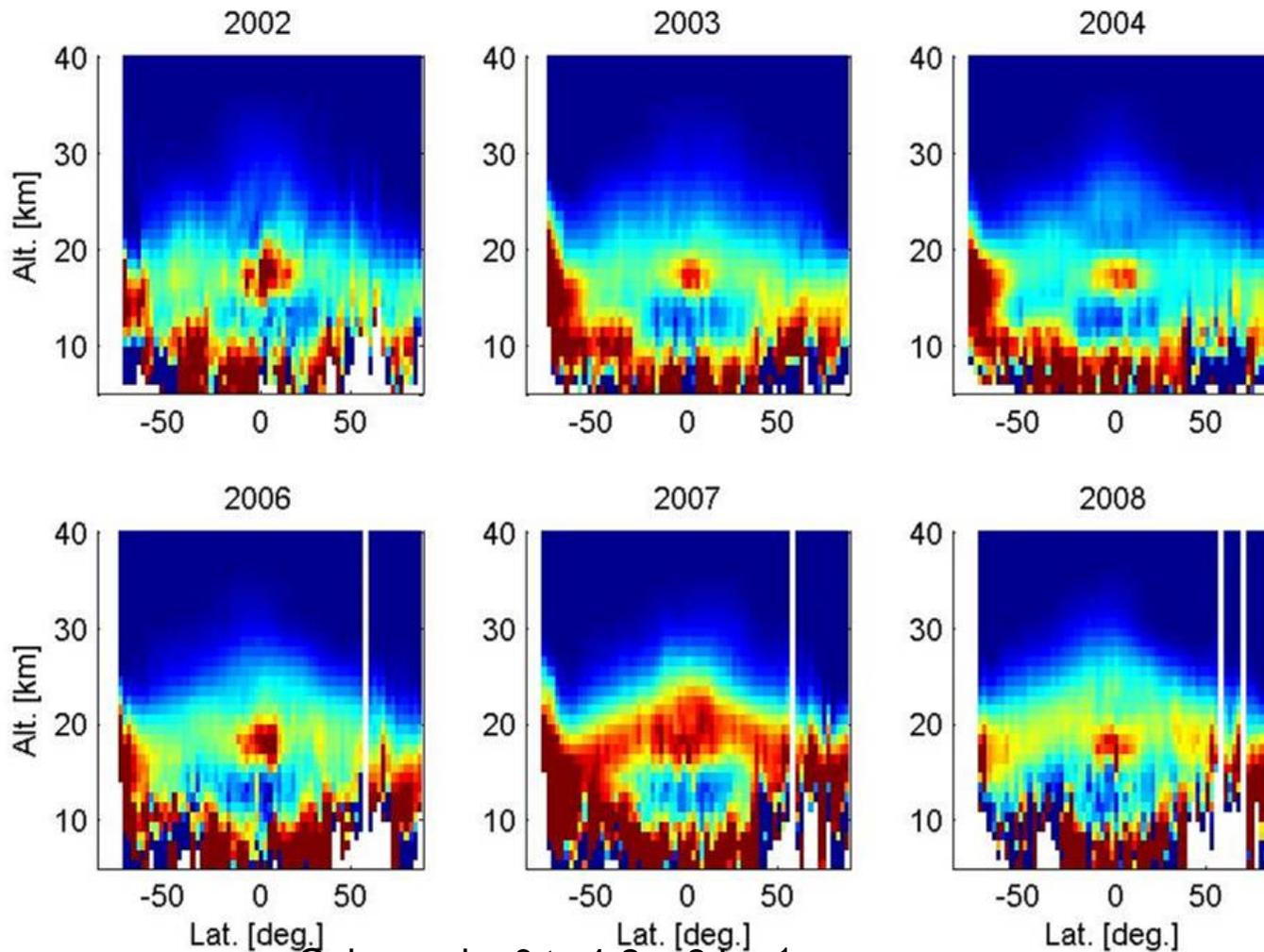
Aerosol ext. 600 nm: yearly zonal means

- stratospheric aerosol layer
- subvisual cirrus clouds in the tropics at about 17 km
- PSCs
- increased extinction in 2007!

Vanhellemont et al., ACP 5, 2005.

Color scale: 0 to 1.2 e-3 km^{-1}

Particle precipitation and stratospheric NO_2 and O_3

Solar protons precipitating into Earth's atmosphere create ions and modify atmospheric chemistry. Locally large ozone losses are produced via the large increases of

Large intrusions of NO_2 into stratosphere are common in polar atmosphere (here Arctic).

NO2 mixing ratio (ppb)

NO2 concentration at 80°N, zonal average
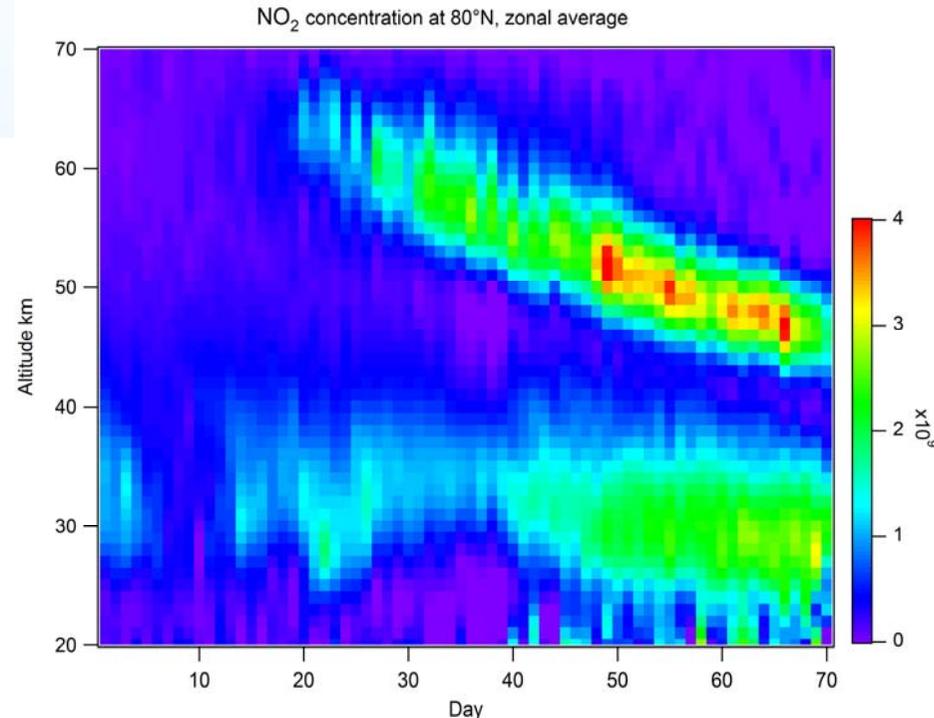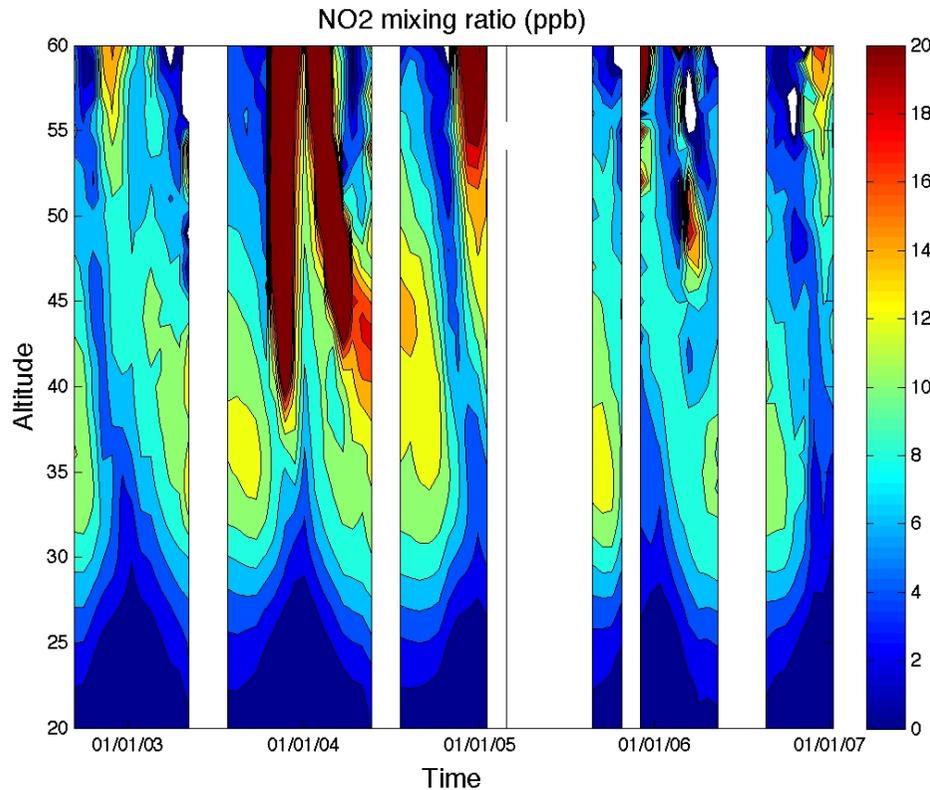
Seppälä, A., et al., GRL, 31, L19107, 2004.
Hauchecorne et al., GRL, 34, L03810, 2007.
Verronen et al., GRL, 33, 24, L24811, 2006

PMC particle size retrieval technique

GOMOS spectrometers A1 and A2: 250 - 700 nm

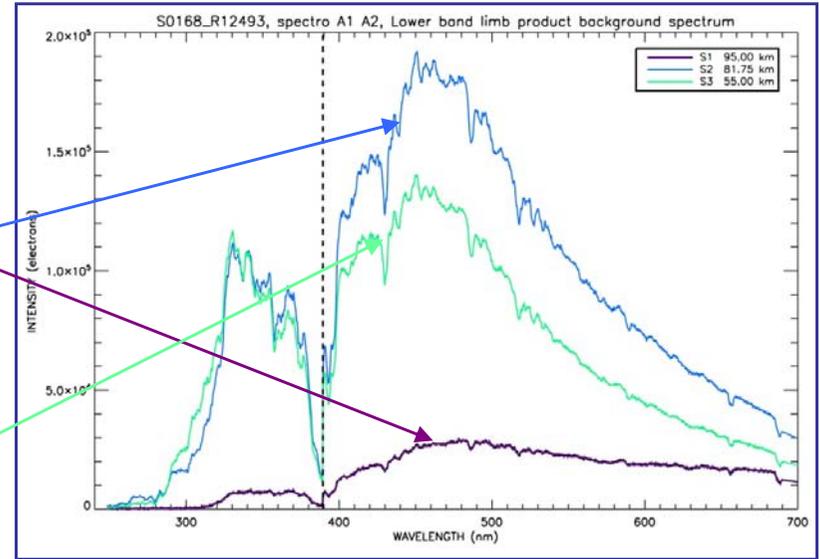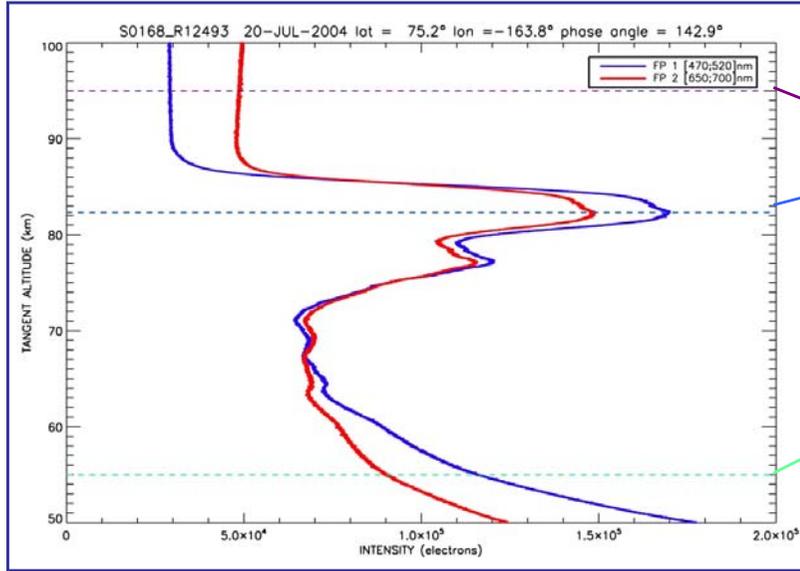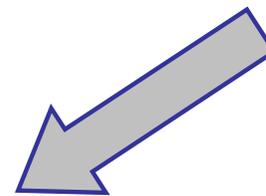GOMOS photometers signals = $S_{star}(z) + S_{molec}(z) + S_{PMC}(z)$
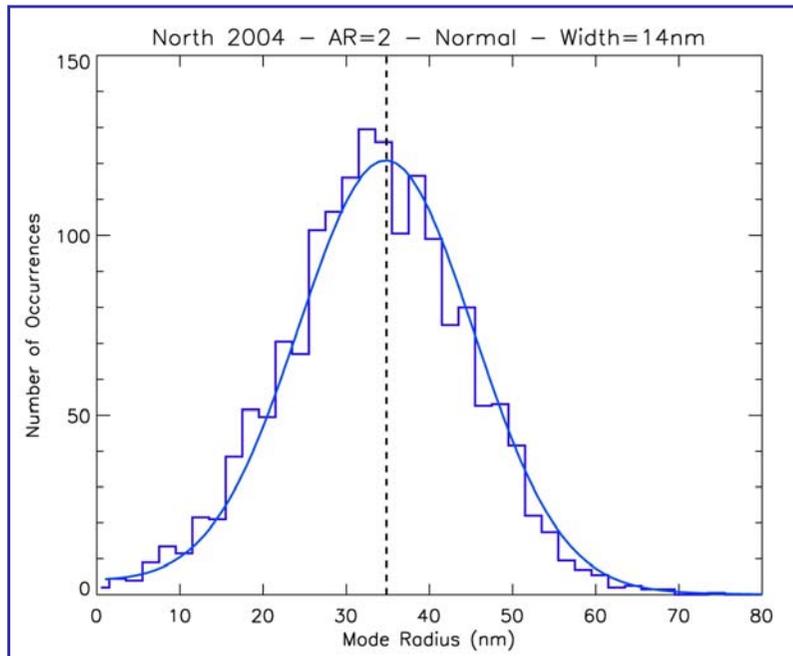
S1: spectrum at 95 km ~ independent on altitude

S2 = S1 + PMC spectrum + Rayleigh (Z_{PMC}) spectrum

S3 = S1 + Rayleigh (55 km) spectrum

Improvements so far
- **Calibration** of the dark charge takes place in each orbit
- **Neutral density fixed** to the values given by ECMWF and MSIS90.
- **Aerosol model** changed from the Angström formula to the second order polynomial model
- **Tikhonov** regularisation in the vertical inversion to smooth oscillations in vertical profiles

The next software version 6
- **Full covariance matrix** in the spectral inversion: spectral correlations from isotropic scintillations
- **HRTP algorithm** is improved
- Calibration procedures have been refined: **intrapixel nonuniformity**

Future
- Retrieval from GOMOS **limb products**.
- **Aerosol model** development.

SIMACC-proposal for ESA Earth Explorer 8
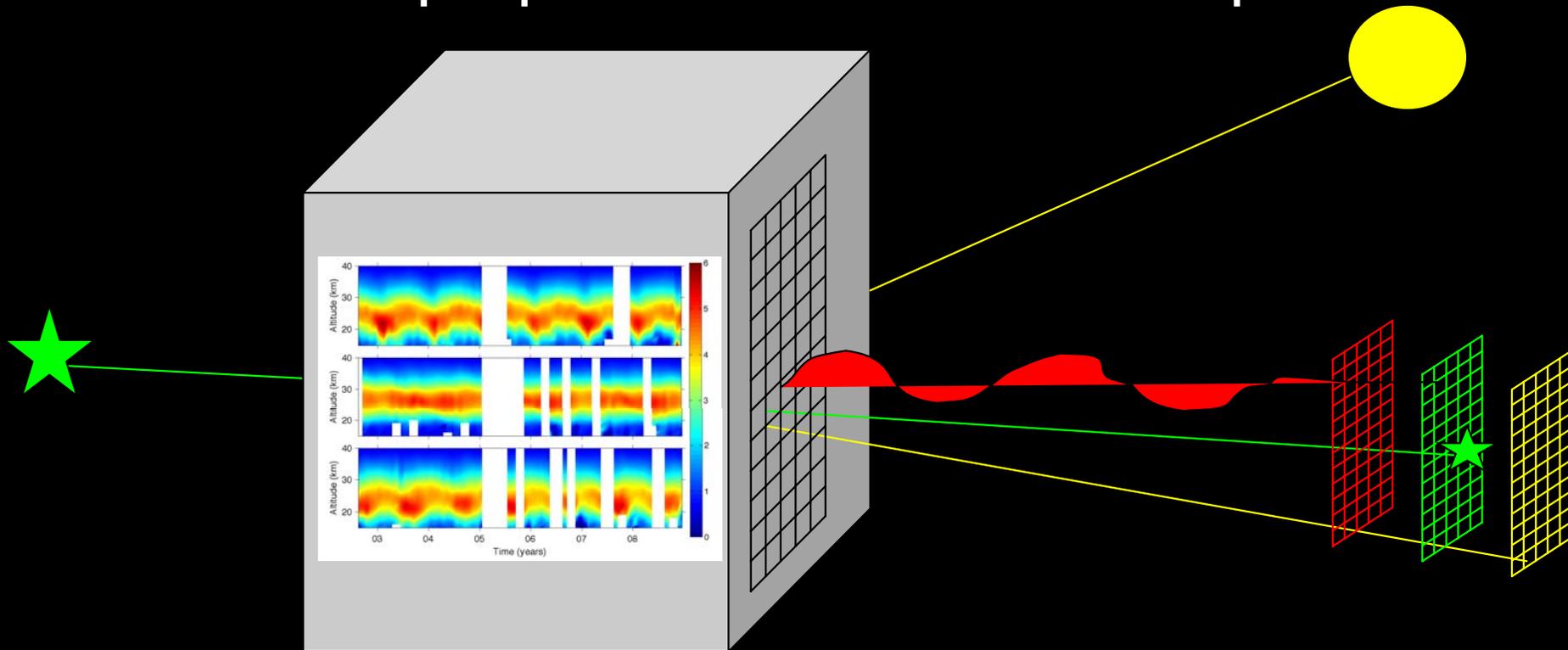
Conclusions

- 8 years of GOMOS measurements (5 years planned)
- O_3, NO_2, NO_3, aerosols, OClO, H_2O, turbulence, NLC
- Difficulties with pointing system, CCD noise

- ACP special GOMOS issue with 15 papers

- Future: SIMACC + new stellar occultation proposals